Metro Atlanta Rapid Transit Authority:

A Simplified Topological Design for MARTA Bus Lines

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Capstone Project

Abstract

The purpose of this capstone project is to explore an alternative to the current maps for the Metro Atlanta Rapid Transit Authority (MARTA). MARTA currently has maps for their high speed rail transportation, each individual bus line, a map of all routes currently serviced by MARTA, and a map focusing on the downtown area's bus lines. Therefore, the research question asks; is there a way to make the maps for MARTA easier to understand for the user? The hypothesis states; using the simplified topological design approach, made famous by Harry Beck's London Underground tube system, the MARTA users can better understand the bus lines they're using. The methodology used is mostly digitizing and re-projecting spatial aspects of the current public transit routes. Three maps focused on bus lines that service: 1) a particular station, 2) a list of tourist destinations, and 3) a mile radius around the Five Points metro stop. Data from the Atlanta Regional Commission (ARC) was used to complete this project. ArcGIS and excel were used to create these maps, as well as Microsoft Paint to present these maps in a neat way. After a thorough analysis, recommendations included: 1) continuing the station example approach for each of the bus stations on the MARTA lines; 2) creating a pamphlet for tourists to use public transportation with the maps created in this project; 3) and considering a different approach for the downtown corridor maps as the detail is lost when looking at such a large scale.

Keywords: Metro Atlanta Rapid Transportation Authority (MARTA), Public Transportation, mapping, Harry Beck

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Introduction:

The Metro Atlanta Rapid Transit Authority (MARTA) is Metro Atlanta's public transportation authority. When it opened in 1971, MARTA was strictly a bus system. After increased funding and an agreement between the surrounding metro counties, MARTA now operates 48 miles (77 km) of rail track with 38 train stations and 100 bus routes covering 25.9 million annual vehicle miles (41.7 million kilometers). MARTA provides transportation services for a daily average of 432,900 passengers. It is the ninth largest public transportation system by ridership in the United States. Along with MARTA, Metro Atlanta is also supported by Cobb Community Transit, Gwinnett County Transit, and Georgia Regional Transportation Authority, which cover the surrounding metro counties for the area. Furthermore the Atlanta Streetcar, which opened December 2015, runs 2.7 miles (4.3 km) east west. The Streetcar serves 12 stops in what's called the Downtown Loop. The Streetcar services many of Atlanta's tourist attractions including; Centennial Olympic Park, The Georgia Aquarium, Auburn Market Distract, and the Martin Luther King Historic National Park. All of these systems combine to create a transit friendly city; however these connections are lost on the user. MARTA utilizes multiple outlets to provide information for their users such as; phone apps with real-time GPS tracking, online images of bus maps, and maps at most bus stops and all train stations. Yet the separation of the transit capabilities represents a key flaw in these maps. Users of MARTA are under the impression that rail and bus do not connect. This project will discuss these maps in detail, specifically its shortcomings and ways it affects the users experience while also providing an alternative to these maps.

Before addressing what simplified topological design is, it is important to understand what it is designed for and how it found its way in public transportation. Henry Charles Beck, known as Harry Beck, was an engineering draftsman from Leyton, London. Beck is best known for creating the present day London Underground Tube map in 1931. He created this map in his spare time while working for the Underground Signals Office. At the time, London's public transportation system was run by multiple organizations servicing much of the city. Each organization had their own set of maps and illustrations to help users understand their own system. Beck's idea was revolutionary at the time because it combined all the systems into one. He thought this would provide the user with an easier understanding of their location relative to the other systems and ultimately ease their passage from one station to another. When Beck presented his map to the Underground they were skeptical and unwilling to present it to the public. However after issuing Beck's map in a small pamphlet it immediately gained popularity, and has been used ever since.

Prior to Beck's design the maps for each service was laid geographically on the road map which meant that stations closer to town were densely populated while the rural areas showed the stations far apart. In 1909 George Dow created a new design, which showed up in many stations around London. Simply put, it was a straight line with each station listed to show the station that came after the other on each line. His map can still be seen in many Tube Stations across London. In addition, a design created by F. H. Stingmore in 1930 came up with the idea to slightly expand the central area of London to show greater detail. Though this distorted the projection of the area it was easier for the user to understand. Many suggest that Beck's design was inspired by Dow's and

Stingmore's creations. However it was Beck who created his full color map in 1931. This map combined some of the ideas from Stingmore and Dow, plus the simplified topological designs he drew while working at the Signals Office.

Before Beck's map, simplified topological design was strictly used in electrical or fine detailed engineering. In Figure 1 you can see an example of this approach. Taking the erroneous details out of the process allows the user to easily understand how the machine works. This is similar to how our brain processes directions. Our brain's only objective is to get us from location A to location B, the details, especially geographic details, mean nothing unless it effects the ultimate destination. This is why in the Tube map we have straight lines and 45-degree angles with a general respect for the overall geographic layout. Figure 2 is a side-by-side map showcasing the actual geographically accurate map of the London Tube system and Beck's design-inspired map.

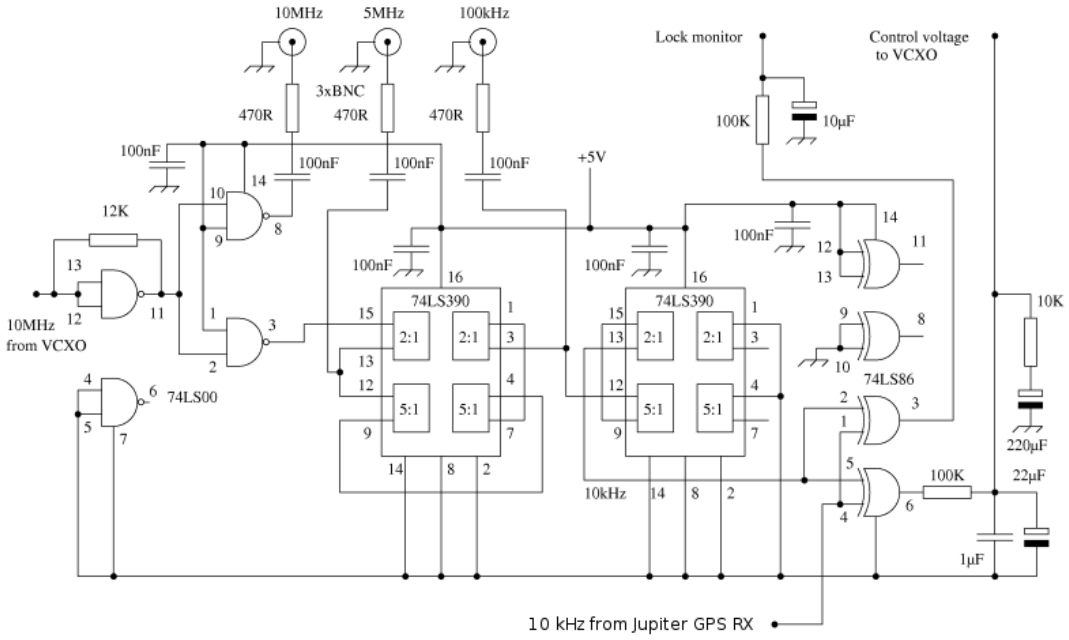
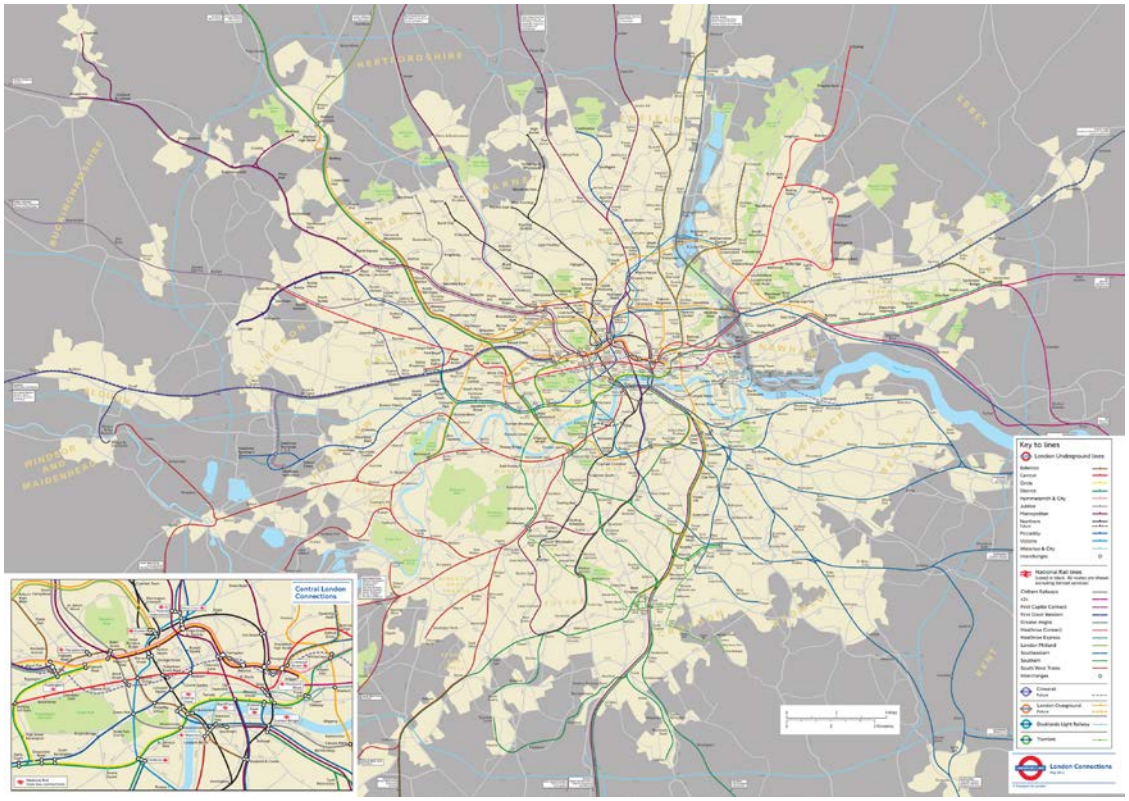


Figure 1: Original GPSDO Schematic


Central London Connections
Key to lines
London Underground lines
National Rail lines
London Overground
Docklands Light Railway
Trams
London Connections

Tube map

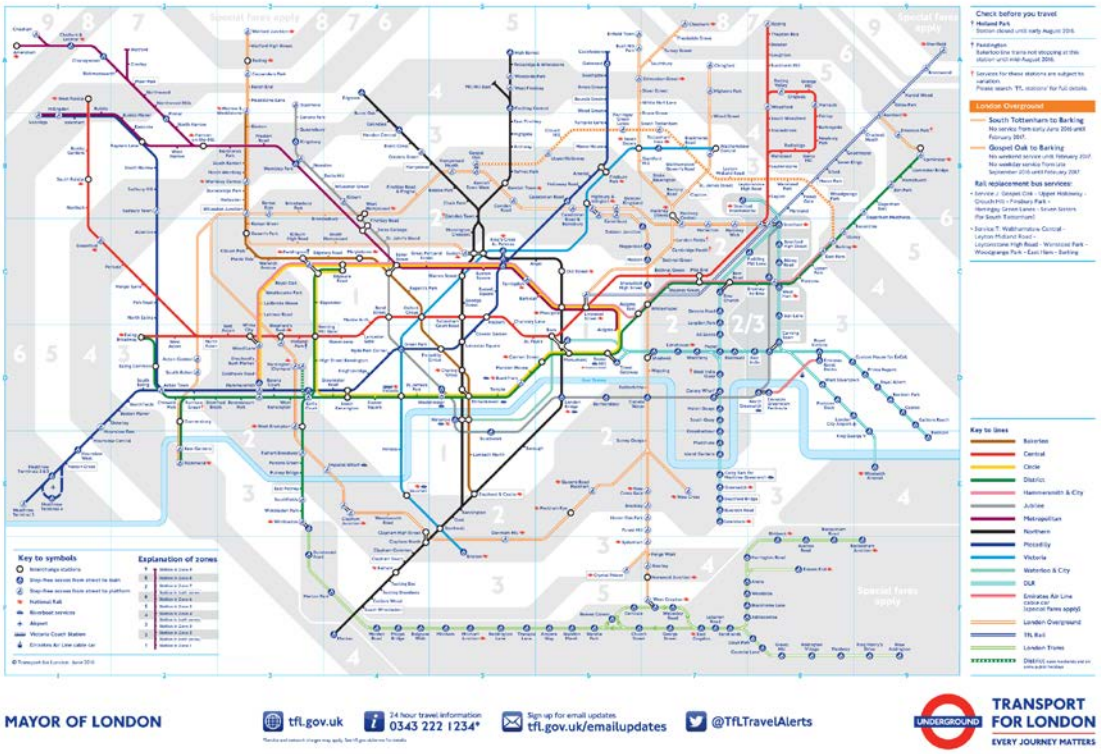

Check before you travel
London Overground
South Tottenham to Barking
Gospel Oak to Barking
Rail replacement bus services
Key to lines
Key to symbols
Explanation of zones
MAYOR OF LONDON
tfl.gov.uk
24 hour travel information
0343 222 1234*
Sign up for email updates
tfl.gov.uk/emailupdates
@TfLTravelAlerts
TRANSPORT FOR LONDON
EVERY JOURNEY MATTERS

Figure 2: A) Real Geographic Representation. B) London Tube Map with Simplified Topological Design

The reason this map was so successful was because of the simplicity of the design. Many suggest Beck's work at the Signals Office was the overdriving inspiration for his map. Drawn like an electric grid each line is easily identifiable and in relation to how it interacts with each other line. Many subway systems around the world eventually adopted Beck's design, including MARTA. Figure 3 shows the rail map for MARTA which is heavily inspired by Beck's design.

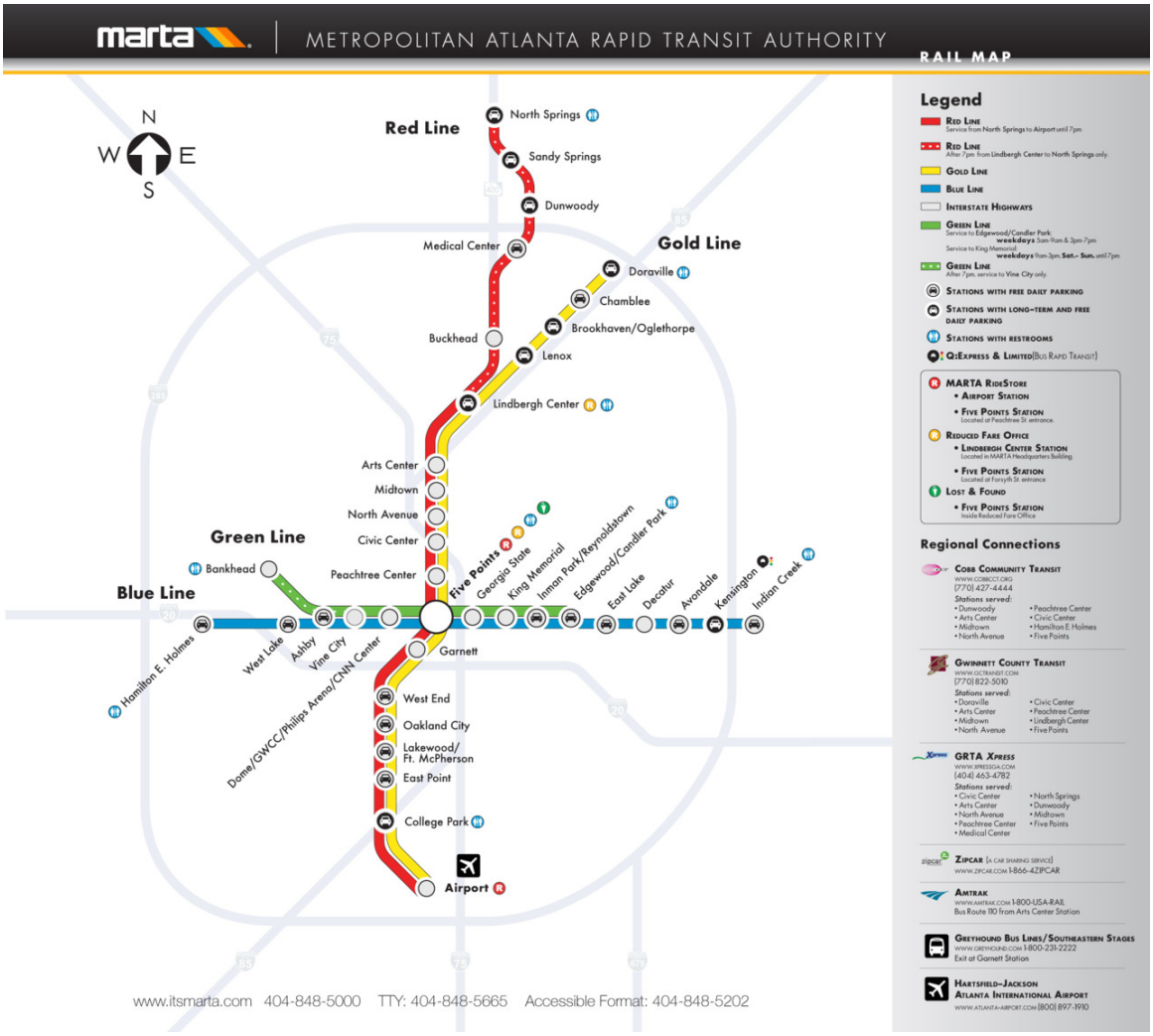


Figure 3: MARTA Rail Map

The inspiration for this project came from a study done by Aris Venetikidis, a graphic designer living in Dublin. When he came upon the maps in Dublin he noticed how confusing and difficult to read they were. Noticing when you got closer to town the bus lines were so dense you could barely understand them or differentiate the lines themselves. This promoted the idea that he could manipulate the map to better assist the user, similar to how Harry Beck had done for the London Tube system in the past. In this project, we have taken Aris' idea and transposed it to Atlanta.

MARTA consists heavily of bus transit; however the bus ridership is 100,000 passengers less a day on average then the rail users. The idea is that the user will be able to comfortably maneuver their way around the system potentially increasing the customer base and creating a larger audience for MARTA. These maps will also increase people's awareness of the connectivity that already lies within MARTA's system. With over 5 million people working, living, and playing in Atlanta every day, a proper and easy to use public transportation system map is essential. MARTA users complain about the lack of transit options in Atlanta, yet when you include bus lines on a map MARTA truly is a world class system.

Main Body: Literature Review

As clearly stated in the *Introduction*, this proposal will redesign the existing MARTA map to better suit the user. Focusing on aspects of the system that are most used by; tourists, workers, and other frequent consumers. Additionally, MARTA will be able to "rebrand" its image with these new maps, similarly to London's iconic Underground

map. With the simplistic design, MARTA may potentially gain new users. For these reasons, a Literature Review is imperative to provide empirical research for theoretical underpinnings. There will be five empirical studies, organized under topical sub-headings, each addressing: 1) a brief overview of methodology and findings; and, 2) relationship to the MARTA Redesign/Rebrand study.

1. **Branding and selling public transit in North America: An analysis of recent messages and methods**
    a. **Research in Transportation Business & Management (2016)**
    b. **Overview**

        Branding plays an important role in influencing public opinion on transit. In recent years, marketing efforts in many cities across America have increasingly featured messages that promote the value of transit. These campaigns highlight that there is a better value with transit than commuting by automobile, a position that is bolstered by a weak global economy, fuel price fluctuations, and growing public awareness and about climate change.

        For many public transit managers, marketing falls outside the necessary operations and becomes unimportant relative to other tasks. This is evidenced by both a gap in literature that dissects best practices and practice that demonstrates using resources on marketing. Because of this complex landscape, the long-term value of public transit marketing relative to marketing efforts across other transportation sectors is unclear.

This study examines the creation of brands for public transportation. They examine best practices and short-term outcomes of advertising.

c. Relationship to MARTA Redesign/Rebrand

Similarly, to London's Underground map or even New York's subway map, the design of these maps is iconic and easily recognized all over the world. This study representing the importance of marketing in regards to public transit is key to this study of the rebranding of MARTA. Taking the system as a whole and rebranding it to a more simplistic and easy to understand system, will better allow infrequent users to navigate the system. MARTA, unlike many other public transit systems around the world is mostly comprised of bus routes. This should not be a hindrance however.

2. The London Underground Map: Imagining Modern Time and Space

a. *Design Issues* (2003)

b. Overview

In this article maps are dissected for what they truly are; representations in time of things that people are in need of. Each map has its own "theme" and represents what's most necessary for the user. In regards to the London Underground map it represents not only the stations and their locations but it helps the user dissect how to navigate to work, or an attraction, or simply around the city. A brief history of the underground system is discussed in this article, including the unification with maps.

In its early stages several different train companies ran the Underground, each having their own maps. This created a sense of disjunction within the city and could become very confusing for Londoners. With Harry Beck's leadership a single map was created that would not only change the face of London but the world of public transit mapping forever.

Beck's map, however, is different than most maps as the geography is essentially "thrown away" for the user. In the case of the Tube, it is unnecessary for the geography and spatial awareness to be present. The user is strictly in need of where to navigate next in their travels around London. In the article this is referred to as discarding geography for the "common sense" of the user.

c. Relationship to MARTA Redesign/Rebrand

In the study I will be conducting I've separated the maps designed into different "themes". Tourism, hotels, and conference centers, will be all for an infrequent user's maps. The Downtown corridor will be for inner-city transfers and an overall rebranding of MARTA that I'd like to complete in future studies/designs. This article discusses the throwing away of geography, my study will be the same. In order to create a simplistic design, the loss of spatial accuracy must be omitted. I will have a basic street system to assist the user in navigating the city, similarly to the Underground Tube map.

3. Mind the map! The impact of transit maps on path choice in public transit

a. Transportation Research Part A: Policy and Practice (2011)

b. Overview

This paper investigates the impact of Harry Beck's diagram style transit maps on passengers' travel decisions. It does two things: First, it defines four types of information delivered from a transit map: distortion, restoration, codification, and cognition. It then considers the impact of this information on three types of travel decisions: location, mode, and path choices. Second, it conducts an analysis to explore the impact of the famous London tube map on passengers' path choice in the system. Using data collected by the transit system from 1998 to 2005, the paper develops a path choice model and compares the influence between the distorted tube map (map distance) and reality (travel time) on passengers' path choice behavior. Results show that the elasticity of the map distance is twice that of the travel time, which suggests that passengers often trust the tube map more than their own travel experience on deciding the "best" travel path. The codification of transfer connections on the tube map, either as a simple dot or as an extended link, could affect passengers' transfer decisions. A known criticism of the Tube map as some of the connections between relatively small interchanges is drastically decreased in the map.

c. Relationship to MARTA Redesign/Rebrand

The design of the new MARTA map will have to be carefully scrutinized to insure optimum travel time for all users. However, this study should be a sign that passengers often consult and entrust their travels on these maps. Still though, the careful selection of even the tiniest symbol as a line representing a connection at rails station is significant for the user. The last thing we want for the redesign is more confusion from the traveler.

Furthermore, the four types of information are great to remember when choosing what to omit from my maps. Or what information; like station name or bus stop location, to keep intact.

4. **Tailoring Map Design Based on Map-Reading and Way-Finding Behavior in Subway Stations**

    a. **Procedia - Social and Behavioral Sciences (2010)**

    b. **Overview**

    This article conducted a study looking at 2D maps versus 3D maps and which was easier for the user to understand. A group was given a task in which all participants were asked to reach an exit without reading a map resulting in no one finding the shortest way to the nearest exit. In the next task, the participants were asked to read a map, plan a route for the exit, and then design a route to get there. The participants using a 2D map were far superior to that of those using the 3D map. The ones using 2D maps used street names while the 3D map users relied heavily on landmarks to navigate to the exit.

    c. **Relationship to MARTA Redesign/Rebrand**

    This article was actually a counter argument to my initial thinking, that the use and representation of landmarks in a map would assist a user better. However, when using a public transit system this study suggests the person is far more intelligent than previously thought of. Strictly keeping to the map and allowing the system to transform in the person's mind is adequate enough for completion of the user's travel. This proves that the London map, though no landmarks are to

be found, is achieving its goal. Replicating that same process to Atlanta should include the absence of landmarks.

5. **Mind the Gap: The London Underground Map and Users' Representations of Urban Space**

    a. ***Social Studies of Science*** **(2008)**

    b. **Overview**

    This paper explores the effects of iconic, abstract representations of complex objects on our interactions with those objects through a study of the use of the London Underground Map to represent the city of London. This paper suggests that the Tube map we're so familiar with is not successful because of its design but because of its presentation with the interaction of urban space. Showing the possibilities and points of access to structures around the city.

    c. **Relationship to MARTA Redesign/Rebrand**

    In the case of the Underground map, it showcases not only the areas within the city but the relation with the suburbs. This is key to understanding the redesign of MARTA. Our system is so large that there is no possible way to represent the entire system, or so we thought initially. With this study, it is possible. The loss of space and the larger scaled enhancement of the urban core allow the suburban areas to taper off while still showing the stations represented. For example, Stone Mountain, which is quite far from the other attractions, can be represented much closer in our maps due to the graphical representation of the map.

In conclusion, I believe study; one, three and five provide the most contribution to the development of my proposal. The first provides an argument and the necessity for marketing and rebranding of public transit systems. In my hypothesis I believe that enhancement of the system to be a rebranding of the maps. In the future to measure this quantitatively we'd need to see if there was an increase in bus ridership. The third study discusses the success of Harry Beck's diagram design on public transit systems around the world. MARTA uses this design already for its rail lines however neglects that consistency when it comes to its bus system. As 75% of the system is bus lines this is a massive pitfall that I hope to remedy. The fifth study represents the importance of Harry Beck's design to mapping transit. When you remove the geographical constraints of the world you can better represent the urban space that users are interested in. In Marta's case that would be attractions for tourists, hotels for business owners, or the everyday user for areas of interested around town to locals.

Methodology:

The ARC is a wealth of open source GIS data for the Atlanta area. The data used in this project was exclusively allocated from their system. To begin the project I downloaded MARTA data including; transit lines, bus routes, bus stops, and stations. Using select by attributes I selected the MARTA lines and stops. Taking some time for data management I removed the duplicate station stops so that I had one stop per MARTA rail station.

Next to complete the tourism map I researched popular tourist stops for Atlanta and the surrounding metro area. This was a simple Google search and I used the top 20 stops listed on that search. This gave me a carrying array of locations around the Metro area

including; Stone Mountain and Six Flags over Georgia. These two locations would showcase the ability of the map to represent vast amounts of space in a smaller section of map.

For each of the three maps created I conducted analysis on the bus routes that operate to and from the destinations. This required a bit of skill as some locations such as the Swan House are a ways from the closest bus route. However when assuming that the user would be willing to walk about a quarter mile to their final destination, it was possible to complete the route.

Once each route was selected a simpler map was taking shape. Without the erroneous details of all the other lines cluttering the space we could focus our attention on what was important to the "theme" of the map. Using the smooth tool and creating new lines, I created a simplified topological MARTA map. Strictly keeping to a regiment of using straight lines, and minimal turns around 45-90 degrees, I was able to create these maps.

Specifically for the downtown corridor map I used a buffer tool of 0.5 miles around the Five Points station to focus on the bus routes around that area. For the station example map we focused on just the bus lines that exited from Midtown MARTA station.

Finally, thanks to a bit of time leftover before the maps were due, I was able to post the existing bus route maps and the newly created maps on my website and conduct a survey to the public for which is more helpful. I also accepted criticism of the maps which I'll give some examples of that criticism in my conclusions and recommendations section of this paper.

Conclusion:

The process of making these maps was difficult at times. To continue the relative geographic spatial correlation while continuing to chip away at the details proved to be more intense than previously thought of. This process ate away at much of the time I previously thought I had, losing my ability to conduct a proper survey. However, even with that pitfall I believe the maps created will truly give a sense of what MARTA should use in the future.

MARTA is mostly made up of bus service lines with four high speed rail lines. The current maps utilized by MARTA are showcased in varying size and degree of detail. The main map that everyone recognizes is the rail map. This uses Harry Beck's simplified topological design, made famous by his London Tube drawing. After taking Aris Venetikidis idea to translate Beck's idea for Dublin bus lines, I came up with a thought to also transpose this to the MARTA bus lines. The idea was that these maps would be better suited for the customer. Three maps were created in my study; a tourism map looking at the top 18 destinations from a Google search for the Atlanta area, a "Station Example" map which showcases the bus lines that leave from a particular station, and a downtown corridor map which looks at a one-mile radius around the Five Points rail station.

When one looks specifically at the "Station Example" map (Appendix A), in this study we looked at the Midtown MARTA station. Midtown has four bus lines that exit from the station. In this map we focused on the main streets that intersect the routes allowing the user to orient themselves to locations around the city. Also showcased on this map are the three additional stations that are serviced by the Midtown busses. This map is a perfect example of the simplified topological design. In the upper left corner of

the map you can see Cumberland Dr. Which is about a 12 mile drive from the Midtown MARTA station, however in this map it is much closer in scale. The reason this is better for the user is simply because the details in-between the start and finish are erroneous, minus a few key streets it crosses.

The “Tourism Map” (Appendix B), would be a great addition to any Atlanta tourism information booth. The Centennial Park area is flooded with millions of tourists a year, and limited parking creates havoc on the downtown traffic. This map provides a transit friendly alternative for tourists. Showcasing 18 tourism stops around the city this map focuses on which line to take, which station the line exits from, and finally the destination itself. Obviously having streets and major landmarks to orient the user would be helpful, however in the time allotted for this project this map creates the idea I was going for in this map.

Finally the “Downtown Corridor” (Appendix C) map took what already exists, the detailed downtown map, and approached it using the simplified topological design. In this map we lost some of the luster of the design. With the large scale, and the need for more detail, we lost the key pull for simple topo. In addition to this complaint, almost all the lines do not start and finish within this one mile radius around Five Points. In conclusion, though the current map for this area exists, neither the current nor the one created in this project are essential to anyone’s needs when using MARTA.

Ultimately the maps were successful in their creation; the jury is still out on if these maps would produce the results this project was looking for. From a general social media survey on Facebook and Reddit the consensus was that the maps are understandable but more work is required on them. Mostly the complaints stemmed from

critiques of the color choices for bus lines and the lack of detail in regards to stops along the routes. While consideration was taken into account for these critiques the decision was made to leave the maps as is. Partly due to the simple fact that adding more detail would clutter the map and creating colored lines seemed to be adding details that is otherwise unnecessary to the map.

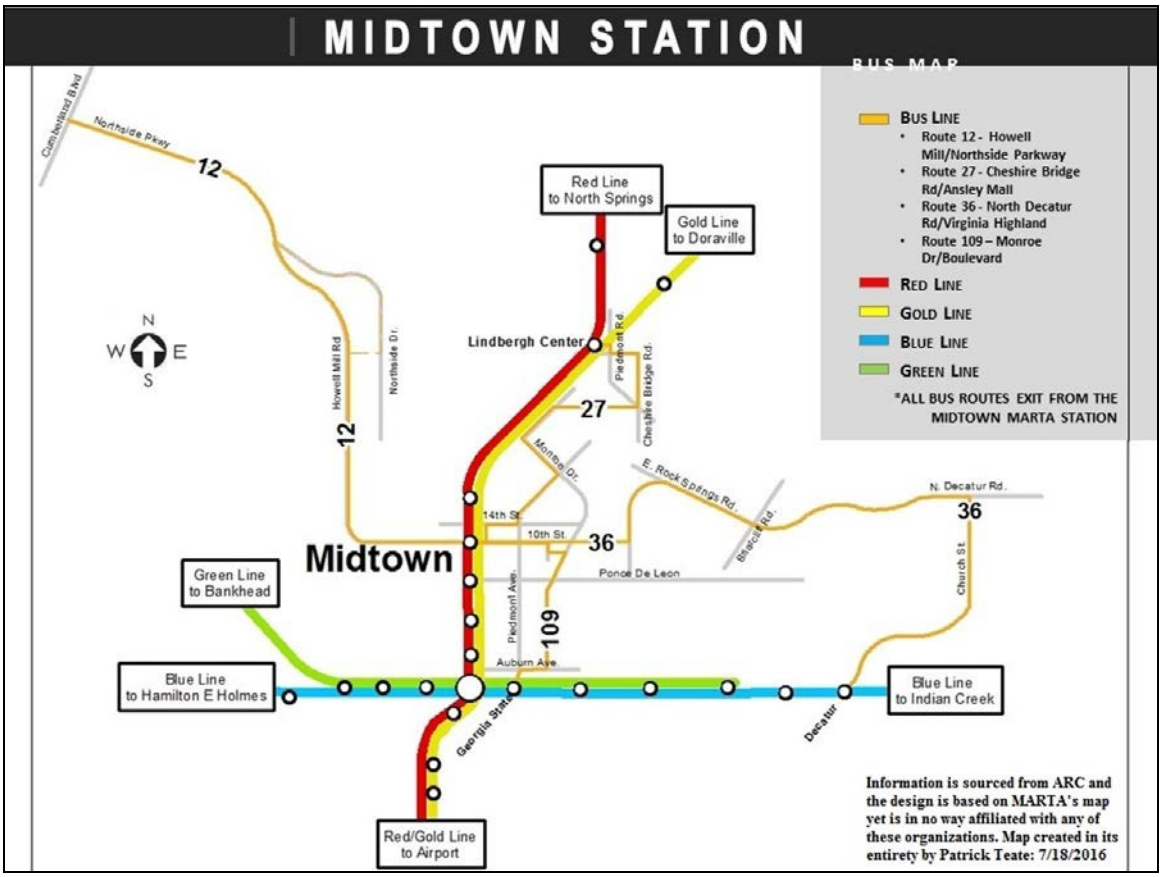
Recommendations for the usage and “branding” of these maps are as followed. In Appendix D you can see some pictures taken from a fact finding mission I conducted during this study. For the Station Example map you can see within the Midtown MARTA station (Image 1) there is plenty of space along the walls and outside kiosks to place the map. The tourism map, as previously noted, would work best within a tourism information booth or a company that deals with tourists. On a small pamphlet this map would make the most sense. Finally the Downtown corridor map might work best in replacement of the current Downtown detailed map, maybe along with the eventual large bus map I’d like to complete in my spare time. In Image 2 you can see this in detail.

In conclusion, Harry Beck’s design of the Underground Tube system changed the world for public transit forever. His design can be seen in almost every public transit system. Using this design to better assist the users of MARTA perhaps could increase the customer base for the system. Ultimately though I believe it would create a more transit friendly community, one that utilizes both rail and bus equally and to its fullest potential. What most MARTA users don’t understand is we already have a world class system, we just aren’t using it properly. With these maps, perhaps we can begin to understand how the system truly works.

Appendix A:

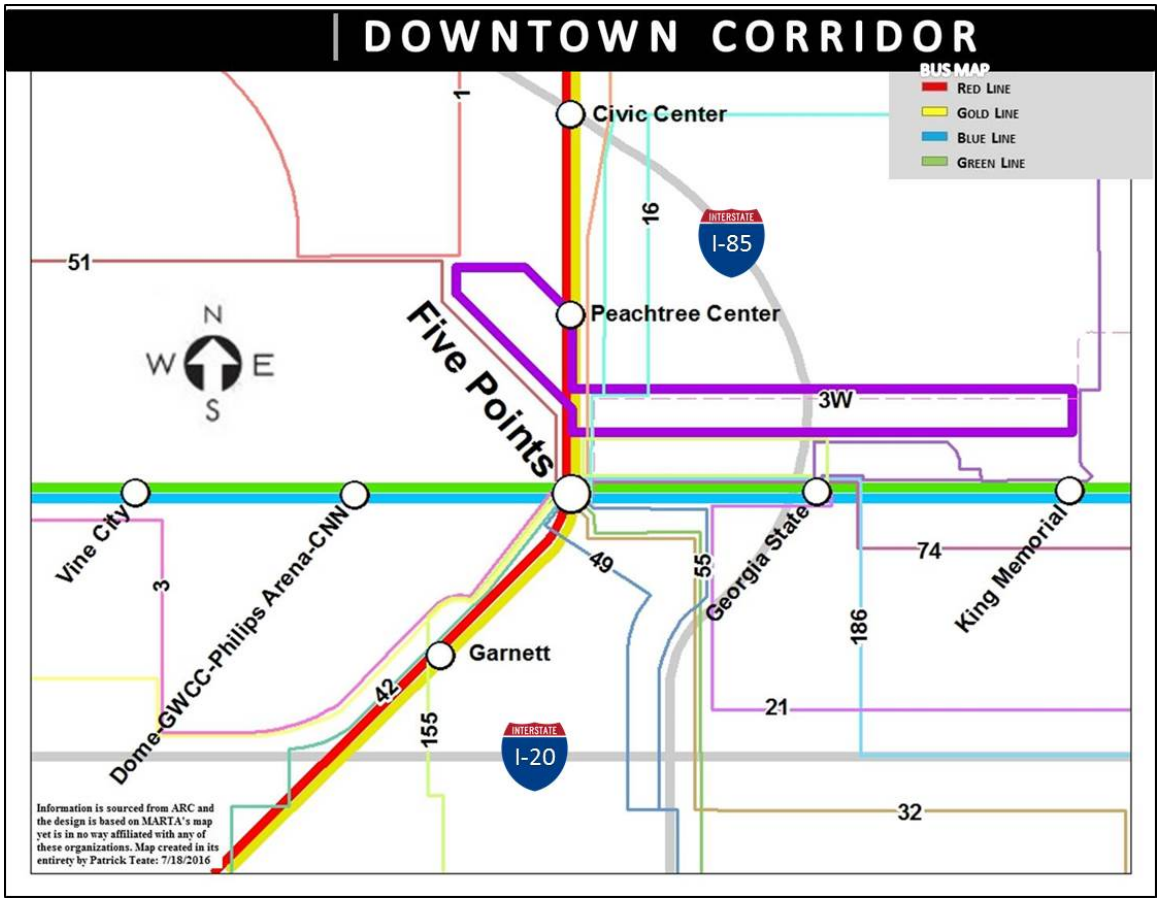
Map 1: Tourism Map

Appendix B:



Map 2: Station Example

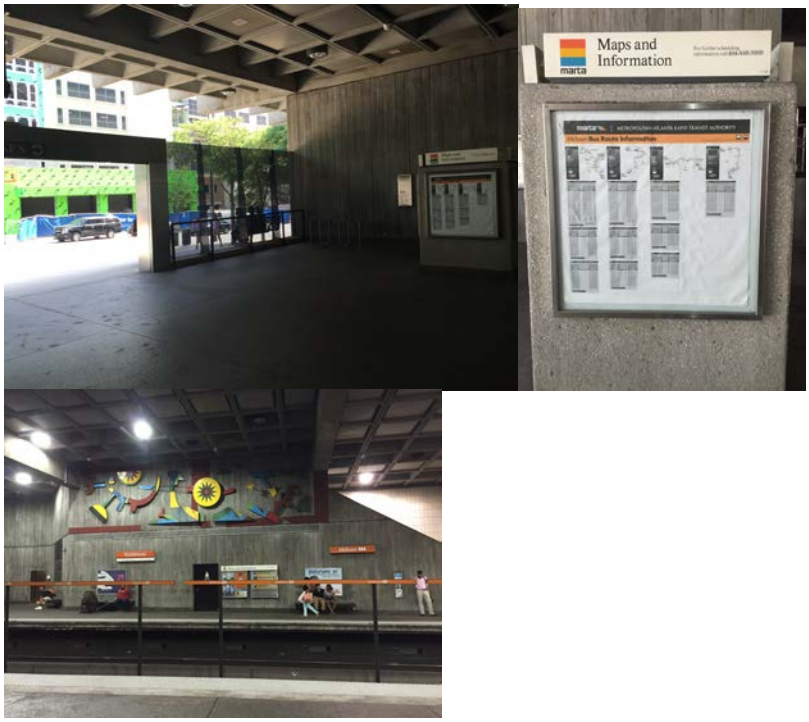
Appendix C:



Map 3: Downtown Corridor

Appendix D:

Image 1



: Pictures taken from Midtown MARTA

Image 2:

: Bus Stop with Detailed bus map.

Work Cited Page:

Figure 1:

http://homepage.eircom.net/~ei9gq/digi.png

Figure 2:

a.) http://i.telegraph.co.uk/multimedia/archive/03443/London-Connections_3443046a.jpg
b.) https://tfl.gov.uk/cdn/static/cms/images/tube-map.gif

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